A prospective, within-patient comparison between metal butterfly needles and Teflon cannulae in subcutaneous infusion of drugs to terminally ill hospice patients

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Abstract: We performed a prospective study of hospice in-patients requiring a syringe driver (SD), to determine the site duration and tolerability of metal butterfly needles compared to Teflon cannulae. Using patients as their own control, prescribed medications were divided equally between two SDs (Graseby MS16a), for delivery over 24 h. A butterfly infusion (Flo-safer\textsuperscript{2}, 25 gauge) was connected to one SD and a Teflon cannula (Abbocath\textsuperscript{®}-T, 24 gauge), to the second. These were inserted subcutaneously (sc) on opposite sides of the body at comparable sites; oedematous, broken or painful sites were excluded. SD sites were examined at 4-hourly intervals. The study was terminated when both devices had required restitting. Needle and cannula times were compared using the Wilcoxon signed rank test. Thirty patients entered the study, 13 males and 17 females, mean age (standard deviation): 70 (11) years. Thirteen patients completed the study. Nine patients died and eight patients discontinued the study before both needle and cannula had been restitted. All 30 patients are included in the analysis. The time from insertion to restitting of the cannula was significantly longer than the needle: P<0.0002, median (range) 93.5 (22.8–263.5) h versus 42.8 (7.5–162.3) h, respectively. The cost of the needle versus cannula is £1.93 versus £2.51, respectively. Teflon cannulae have a median life span twice that of metal butterfly needles and are a cost-effective alternative for administration of medications by sc infusion in terminally ill patients. Palliative Medicine 2002; 16: 13–16

Key words: metal butterfly needle; subcutaneous; Teflon cannula; terminal care

Mots-clés: aiguille butterfly métallique; canule en Teflon; soins terminaux; sous-cutané
Introduction

The use of syringe drivers (SDs) to deliver drugs subcutaneously (sc) is now widespread in palliative care.\textsuperscript{1,2} A continuous sc infusion achieves a steady plasma concentration of drugs.\textsuperscript{3} It reduces the need for oral medications, regular suppositories or injections. SDs are indicated in patients with nausea, vomiting, intestinal obstruction or dysphagia. They are commonly used for administration of drugs in the terminal phase.\textsuperscript{2}

A number of drugs can be delivered using an SD including analgesics, anti-emetics, anxiolytics and sedatives. SDs are generally well tolerated but there can be problems with site reactions such as redness, swelling, tenderness and bruising. Drugs such as diazepam and prochlorperazine, which are irritants, are more likely to cause site reactions and can lead to the formation of sterile abscesses. Site reactions can also be caused by the infusion set. Metal needles or Teflon cannulae can be used to administer drugs (Figure 1). There is some evidence to suggest that Teflon cannulae are less irritant;\textsuperscript{4,5} however, they cost more and may kink, disrupting drug administration.\textsuperscript{6}

Absorption of drugs sc is dependent on both the type of drug and the volume of solution used.\textsuperscript{7} It will also be affected by body habitus, particularly the volume of sc fat. This can be a problem for severely cachectic patients. The sc blood flow will affect rate of absorption;\textsuperscript{8} in patients who are peripherally shut down, absorption will be reduced. Other patients who can experience problems include those with lymphoedema or severe peripheral oedema. Oedematous sites should be avoided not only because of poor absorption, but also because of the increased risk of infection.

The aim of this study was to determine the difference in time from needle insertion to site reaction using metal needles versus Teflon cannulae, for sc administration of drugs in terminally ill patients. The principal difference in design of this study, compared to previous studies that have tried to answer this question\textsuperscript{1–6,9} is that the patients were used as their own control. This allowed differences in drug combinations, drug volumes and body habitus to be controlled and needle and cannula to be directly compared.

Methods

Following approval from the local ethics committee, in-patients who required an SD were asked whether or not they would participate in the trial. Written informed consent was obtained. Prescribed medications were divided equally between two 10-ml syringes and made up with water for injection to 50 mm of plunger travel. The drugs were delivered by two SDs (Graseby MS16a), calibrated and set at 2 mm/h. A butterfly infusion (Flo-safer\textsuperscript{2} infusion set, 25 gauge, Sims Graseby), with an integral 100-cm connecting line, was connected to one SD. The line was primed and the needle inserted sc, at an angle of 45° to the skin. A Teflon cannula (Abbocath\textsuperscript{1} -T, 24 gauge, bms Critical Care) was inserted sc, at an angle of 45° to the skin, on the opposite side of the body at a comparable site (e.g., right arm and left arm). This was attached to a primed 100-cm connecting line, connected to the second SD. Both sites were covered with a Tegaderm dressing. Sites were excluded if they were oedematous, broken or painful or if there was asymmetry of body habitus.

It is normal practice for SD sites to be examined 4 hourly. For the purpose of this study, nurses were
requested to make a written assessment 12 hourly, grading redness, swelling, tenderness, bruising and leaking according to a four-point scale (none, slight, moderate and severe). The infusion site was changed when reactions arose as per normal practice and the SD resited in a different position on the same side of the body. The date and time of resiting was recorded. This continued until either the patient died or both the needle and cannula sites had required resiting.

Patients were excluded from the study if they were unable to give informed consent, if they required more than two SDs or if they had an estimated prognosis of less than 24 h.

The calculated times from entry into the study to resiting of the needles or cannulae were not normally distributed. Needle and cannula times were compared using the Wilcoxon signed rank test.

Results

Thirty patients entered the study, 13 males and 17 females, mean age (standard deviation): 70 (11) years. Thirteen patients completed the study, requiring both needle and cannula to be resited. Nine patients died and eight patients discontinued the study before both needle and cannula had been resited. Two patients withdrew due to subsequent confusion. Two patients found having two SDs burdensome and two patients were transferred to oral medications due to resolution of their nausea and vomiting. One patient required recurrent resiting of the needles (×5) and all medication was then given by the cannula and one patient was withdrawn due to protocol violation. The majority of patients had metastatic malignant disease; one was suffering from motor neurone disease. The different drugs prescribed are shown in Table 1. All 30 patients are included in the analysis.

The time from insertion to resiting of the cannula was significantly longer than the needle: \( P < 0.0002, \text{median (range)} \) 93.5 (22.8–263.5) h versus 42.8 (7.5–162.3) h, respectively. The most frequent reasons given for resiting the needle were:

1) redness and swelling;
2) bleeding.

Redness and swelling’ was the commonest reason quoted for resiting the cannula; bleeding was not recorded.

Most patients did not express preference regarding the comfort of either device, except for two patients, who required four and five needles compared with one cannula. They expressed a preference for the cannula since it obviously reduced the need for frequent resiting.

Nursing staff commented that the connecting lines used with the cannulae were stiffer and therefore harder to place. The connecting port was bulkier and did not lie flat against the skin. They felt that this made the cannula more uncomfortable. However, the patients did not find this.

Discussion

We chose to compare this Teflon cannula with the standard metal butterfly needle as this product is available on the National Health Service in the UK. It is therefore accessible to hospitals, hospice and primary care teams. In addition, this device is inserted at 45° and is comparable to the metal needle in this respect. The Sof-set® device used in a previous study by Macmillan et al.,⁵ is inserted at 90°. It is possible that skin reactions may be masked for longer with this cannula affecting direct comparison with the metal needle. The Sof-set® infusion set is an integral system, unlike the cannula, which requires attachment of a plastic tubing, but it is also more expensive and not available through the National Health System.

The costs of the needle versus cannula (including connecting line) used in this study are £1.93 versus £2.51, respectively. Given that the median cannula time was double that of the needle, this cannula is a cost-effective alternative to the standard butterfly needle. In addition, there would be a saving of nurse time because the device would not need resiting so frequently.

Our results show that the metal needles lasted for a median of 1.8 days and the cannula for 3.9 days. This is shorter than times quoted by Dawkins et al.,⁴ who found the metal needles lasted a median of 4 days and the cannula 6 days. However, Dawkins et al. included less than half the number of patients entered into their study in the analysis. All patients entered into our study were included in the analysis to reduce bias. For those who died or withdrew prematurely from the study, we will have underestimated the true time from insertion to

<table>
<thead>
<tr>
<th>Medication</th>
<th>Number of patients</th>
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<tbody>
<tr>
<td>Diamorphine</td>
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<tr>
<td>Metoclopramide</td>
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<td>Hyoscine hydrobromide</td>
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</tr>
<tr>
<td>Dexamethasone</td>
<td>10</td>
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<tr>
<td>Fentanyl</td>
<td>1</td>
</tr>
<tr>
<td>Cyclazine</td>
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<tr>
<td>Ketamine</td>
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<td>Haloperidol</td>
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<td>Midazolam</td>
<td>6</td>
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<td>Phenobarbitone</td>
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failure of the cannula and in some cases the needle, since the time of death/withdrawing was used in calculations. Moreover, since in every patient the cannula lasted longer than the needle, the true additional benefit of the cannula is likely to be greater than that calculated.

A previous study has reported problems due to kinking of a 22-gauge Teflon cannula. This was not found to be a problem in our study and may be explained by differences in the specific cannula used. Currow and Cooney used a 24-gauge Teflon cannula and did not report problems with kinking. Needle stick injuries are reported to be reduced by using cannulae compared with metal needles. We did not have any needle stick injuries reported during this study.

It is possible that particular drugs or specific patient groups will have greater benefit from the Teflon cannulae. Our study was not designed to test this. We did note, however, the increased reporting of bleeding as the reason for restiting the metal needles. This may be important in those with clotting abnormalities, or who are formally anti-coagulated.

One patient withdrew from the study before the cannula was replaced, but had required five needles restiting over the same time period. He was a gentleman with carcinoma of the bladder and renal failure and was receiving diamorphine, dexamethasone and levomepromazine via an SD. It is not known whether certain drugs cause increased site reactions when in contact with metal. We have previously observed patients whose skin reacts in a similar way to the butterfly needle, but do not have sufficient numbers to isolate common risk factors. However, it would seem sensible to use a cannula in those patients who have not been able to tolerate SC infusions through a butterfly needle.

There are multiple difficulties with research in palliative medicine. Patients are often very unwell and this results in a large proportion of patients either withdrawing from studies or dying before data collection has been completed. Our study further demonstrates this problem. Every effort was made to explain clearly to patients (and relatives) the purpose of the study and, in general, patients were keen to participate where possible.

Our study shows that Teflon cannulae have a median life span twice that of metal butterfly needles and are a cost-effective alternative for administration of medications by SC infusion in terminally ill patients.

**Funding/conflict of interest**

None.

**Acknowledgements**

We are grateful to the nursing staff of St Joseph’s Hospice, especially Lourdes Ward, for their help and support in collecting the data for this study.

**References**